Modern management in vertebral metastasis

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Abstract

Vertebral metastases (VB) remain a real challenge in spine surgeons. Recent advancements in surgical techniques and oncological management allow a more aggressive approach of the patient with such a pathology, with better results in terms of decreasing pain, improvement of the quality of life. The aim of this paper is to review the optimal surgical planning in metastatic spinal tumors.

Keywords: vertebral metastases, surgery, surgical staging system, preoperative prognostic score

Introduction

It is well known that the liver and lungs are the most common distant sites for carcinoma. Bone – vertebral column is the third site affected (1). The most common primary malignancy is prostate cancer for men, followed by lung and colon cancer (incidence ranging from 160.4 to 65.0 cases per 100,0000; for women the first cause for vertebral metastases is the breast cancer, followed by the same malignancies as in men (incidence ranging from 128.9 to 47.0 cases/ 100,000). The primary spinal tumors are rare as comparing with metastases (2).

Recent advancement of oncological management improved the survival rate of patients with malignancies, including the ones with vertebral metastases; so spinal surgeons are faced very often with such of patients and they have to decide which is the best way to deal with this kind of pathology.

Vertebral metastases occur in all age groups, with the highest incidence between age 40 and 65 years (3). Improvement in cancer management leads to increasing survival rate, thus to more patients with spinal secondary lesions. Cancers of breast, renal, lung, prostate are the most frequent primary lesions which will develop spinal secondary lesions (4). Classic autopsy studies of Willis (5) have demonstrated that the size of vertebrae is related with secondary lesions. Thus the most affected is lumbar region followed by thoracic spine and rare cervical spine. Despite this, today the studies show that the most affected is thoracic spine (60% to 80%), followed by the lumbar spine (15% to 30%), and finally the cervical spine (less than 10%) (6), probably related to the smaller size of thoracic spinal canal. In transverse plan of vertebrae the most affected site is the vertebral body (85%), paravertebral spaces (10-15%), epidural space (<5%), intradural/intramedullary (7).

Even today we can encounter physicians considering the appearance of a spinal metastasis to be the death "signature" for patients with carcinoma. Advances in imaging, early diagnosis, new surgical techniques – more aggressive, associated with oncological treatment allow to improve the management of this patients "too sick to be treated".

Treatment

The three basic treatment modalities in vertebral metastasis are chemotherapy, radiotherapy and surgery.

Chemotherapy includes antitumor medication, steroids and biphosphonates.It is very important to know the sensitivity of the tumor to chemotherapy prior to treatment.

Krakoff defines three types of tumoral sensitivity to chemotherapy (8):

Higly sensitive

1. Childhood cancers like acute lymphocytic leukemia,

Wilms tumor, Ewing's tumor, retinoblastoma, and rhabdomyosarcoma.

2. Hodgkin's lymphoma.
3. Carcinoma of the testis.
4. Choriocarcinoma.
5. Burkitts tumor.
6. Acute promyelocytic leukemia.

In many centers chemotherapy is considered the primary treatment for patients with these tumors even in the presence of epidural compression (9):

Moderately sensitive

1. Adenocarcinoma of breast.
2. Non-Hodgkin's lymphoma.
3. Lung cancer.
4. Osteosarcoma.
5. Adult myeloid and lymphocytic leukemia.
6. Carcinoma of the prostate.
7. Colorectal carcinoma.
8. Female cancers of the ovary, endometrium, and cervix.

Minimally sensitive

1. Endocrine gland cancers.
2. Malignant melanoma.
3. Hepatocellular carcinoma.
4. Renal carcinoma.
5. Pancreatic carcinoma.

Steroids are used for the control of biologic pain and vasogenic edema to help stabilize neurologic dysfunctions in pre- and postoperative periods.

Biphosphonates tend to inhibit osteoclast reabsortion of bone matrix and decrease bone turnover. There are three generations of biphosphonate currently available.

Radiation Therapy (RT) remained an important tool in these patients treatment. Since 1970's RT replaced laminectomy as first-line therapy for patients with spinal metastasis and cord compression. Recent studie (10) have confirmed the utility of RT for the treatment of patients with spinal metastasis. The standard RT treatment for palliation of spinal metastasis is a total dose of 3000 Gy; higher doses increases the risk for pathologic myelopathy and functional spinal cord transection. Today new radiation techniques are available: intraoperative RT, 3-D conformal RT, and intensity-modulated RT. All these techniques may permit the delivery of a higher dose of radiation to a target tissue while maintaining the dose to the spinal cord at a much lower level.

Surgical management

Surgical treatment of vertebral metastases is a real challenge for a spine surgeon. There are many strategies currently available for this disease, starting with observation to aggressive en bloc spondilectomy. Furthermore, it is not enough to asses the patient only from the surgical point of view, it's mandatory to asses the stage of his cancer, needing a multidisciplinary team. Patients with spinal metastases are often compromised and at higher risk for surgical and medical complications after aggressive treatment.

McLain (11) identifies the steps for a successful surgical plan:

1. Identify and characterize the tumor.

2. Classify the tumor as stage and extension.

3. Identify an indication for surgery - relative or absolute.

4. Review the non-operative options.

5. Review the options for resection and reconstruction.

6. Determine the role of adjuvant therapy.

There is no clear cut indications for surgery in vertebral metastases; however, there are some circumstances accepted as surgical candidates (12), (13):

1. Unknown or impossibility to establish the histological diagnosis

2. Neurological compression owing to pathological fracture with bony impingement, vertebral collapse more than 50% of vertebral height, kyphosis more than 50^{o};

3. Mechanical instability with severe pain or impending neurological injury.

4. Tumor progression in face of, or following radiotherapy.

5. Known radio-resistant tumor.

6. Resectable solitary metastasis in patient with potential long-term survival.

There are also some relative contraindications:

1. longstanding complete paralysis (more than 24 hrs)

2. highly radiosensitive tumor (lymphoma, myeloma)

3. multiple levels of involvement

4. poor life expectancy (less than 3 months)

5. extreme medical comorbidities

An important issue is timing of surgery, especially for the patients with neurological deficits. Complete paralysis has less chances to recovery after 24 hours. However, surgery is indicated in patients with partial neurological deficits appeared for 3 days or less (14).

Terminology and Surgical Staging/Preoperative Prognostic Score

It is necessary to establish some definitions in order to describe the degree of tumoral resection in spine. The surgery of musculoskeletal tumors delineates the resection as intralesional, marginal, wide, and radical margins. In spine surgery this radical margins are very difficult to achieve due to presence of neural elements. That's why the applications of the oncological staging systems for long bones such as Enneking system for the surgical staging of bone and soft-tissue tumors is difficult (15).

There are many surgical staging systems, and prognostic systems designed to evaluate each patient in order to choose the optimal surgical treatment.

In 1997, Weinstein, Boriani and Biagini describe the terms of surgical resection and surgical staging system (WBB) (16):

"Curettage" – piecemeal removal of the tumor – intralesional procedure

"En bloc" – removal of the tumor in one piece, alltogether with a layer of healthy tissue. The piece has to be sent to histological studies to define "intralesional", "marginal" or "wide" (15) as shown in Figure 1.

"Radical resection" – en bloc removal of the tumor and the whole compartment of tumor origin. This is practically impossible in spine tumor due to presence of nervous tissue.

" Palliation" – surgical procedure with a functional purpose – spinal cord decompression, fracture stabilisation +/- partialor piecemeal resection of the tumor leading to control the pain, improvement of neurological deficit.

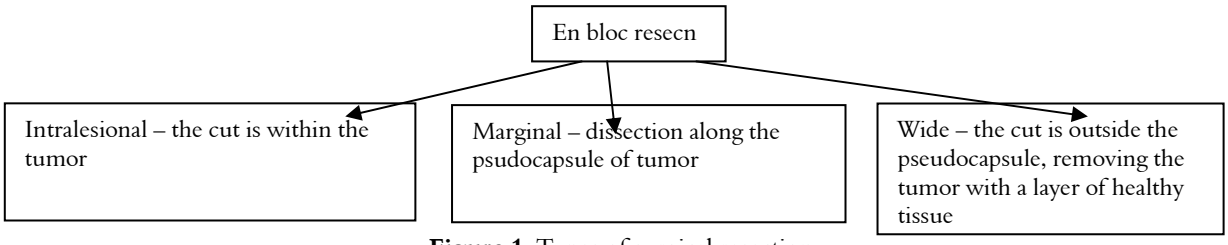

Figure 1 Types of surgical resection

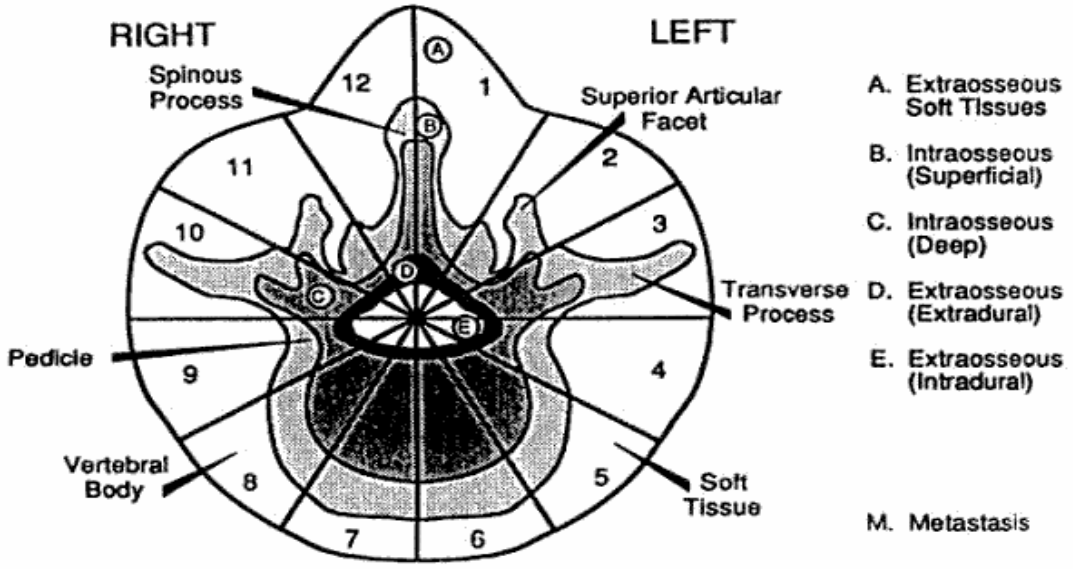

Figure 2 WBB surgical staging for spine tumors - in axial plane the vertebra is divided in 12 radiating zones and 5 layers (from A to E). (from WBB Surgical Staging System, 1997)

There are 3 methods for performing en bloc exicisions depending of tumor's location (16):

• Vertebrectomy (marginal/wide en bloc excision of the vertebral body) – tumor is located in zones 4 to 8 or 5 to 9, and at least one pedicle is free from tumor.

• Sagittal resection (marginal/wide) - tumor is located in zones 3 to 5 or 8 to 10, which means that it is situated eccentrically within the body, pedicle, transverse process.

• Resection of posterior arch resection (marginal/wide) - tumor is located in zones 10 to 3.

Although WBB system is designed for primary spine tumors, it can be successfully used for spine metastases.

In 2001 Tomita discloses his results using another scoring system for spinal metastases using 3 prognostic factors (17) as shown in Table 1.

1) grade of malignancy (slow growth - 1 point; moderate growth - 2 points; rapid growth – 4 points),

2) visceral metastases (no metastasis - 0 points; treatable - 2 points: untreatable - 4 points),

3) bone metastases (solitary or isolated - 1 point; multiple – 2 points).

Prognostic score between 2 and 10.

Another scoring system was proposed by Tokuhashi (18). It is a preoperative prognostic scoring system taking into account six variables in order to evaluate life expectancy of the patients (table 2).

Aggressive surgery is reccomended for patients having a score of 9 or more and palliative surgery for scor of 5 or less.

Hecht (19) describes surgical strategies according to life expectancy and surgical staging using Tomita and Tokuhashi scores. (Table 4)

Table 1

Tomita preoperative prognostic score

Scoring System				Prognostic Score	Treatment Goal	Surgical Strategy
Point	Prognostic factors: Primary tumor	Visceral mets.*	Bone mets.**			
1	slow growth (breast, thyroid, etc.)		solitary or isolated	2 / 3	Long-term local control	Wide or Marginal excision
				4 / 5	Middle-term local control	Marginal or Intralesional excision
2	moderate growth (kidney, uterus, etc.)	treatable	multiple	6 / 7	Short-term palliation	Palliative surgery
4	rapid growth (lung, stomach, etc.)	un-treatable		8 / 9 / 10	Terminal care	Supportive care

* No visceral mets. = 0 point. ** Bone mets. including spinal mets.

Table 2

Tomita's local extension of lesion

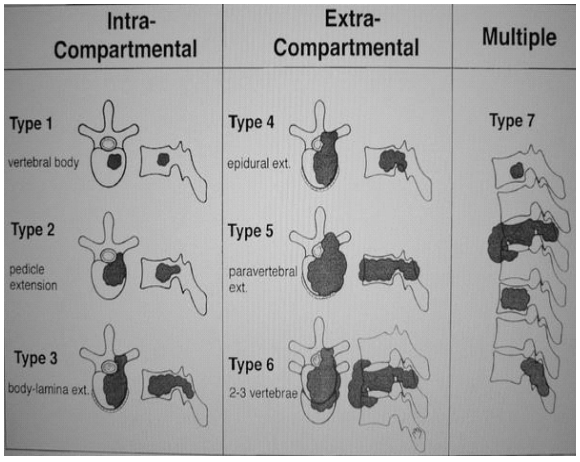

Table 3

Tokuhashi prognostic scoring system

General status	Score	Metastases to major internal organs	Score
General condition (Karnofsky)		Nonremovable	0
		Removable	1
10-40	0	None	2
50-70	1		
80-100	2		
No of extraspinal bone metastases			
>3	0	Lung, stomach	0
2	1	Kidney, liver, uterus	1
1	2	Thyroid, prostate, breast, rectum	2
No of metastases in the spine		Neurological deficit	
>3	0	Complete	0
2	1	Incomplete	1
1	2	None	2
Tokuhashi score		Life expectancy	
0-4		<3 months	
5-8		<6 months	
9-12		>6 months	

Table 4

Surgical strategies according to life expectancy and Tomita and Tokuhashi scores

Tokuhashi score	Life expectancy	Tomita scoring system	Surgical technique
0-4	<3 months	1-7	Laminectomy +fixation
5-8	3-6 months	1-7	Posterior decompression + fixation +reconstruction
9-12	>6 months	1-3	En bloc resection +reconstruction 360°
		4-6	Intralesional vertebrectomy+ reconstruction 360°
		7	Posterior decompression and fixation

Discussion

The management of patients with spinal metastases is frequently a challenging task, with many risks. In the past the treatment was radiation therapy associated or not with laminectomy; but laminectomy alone leads to secondary aggravation of the neurological deficit due to increased spine instability. Therefore, more sofisticated techniques were developed for this kind of lesions including anterior/anterolateral approaches combined or not with posterior approaches, tumor removal in different ways, associated with reconstruction and stabilisation.

This techniques allowed a more aggressive tactics, improving the survival rate and the quality of life. This more extensive /aggressive surgical technique prolonge significantly the survival rate – 18,8 month for en bloc resection compared with 3,7 month for palliative surgery (4).

The most important issue in dealing with spine metastases is a proper assessment. It can be done using surgical staging systems and preoperative prognostic scores as described above. However, there is a lack of standardization of the surgical terms sometimes is used the same term for different surgical procedures (20).

Using this instrument it is possible to choose the optimal treatment for the patient (avoiding overtreatments or undertreatments - patient too sick to be treated).

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